THE MODEL ENGINEER

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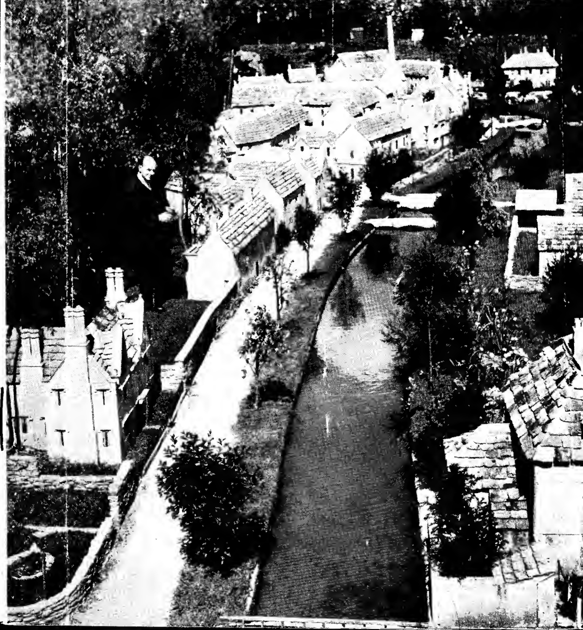


The MODEL ENGINEER

PERCIVAL MARSHALL & CO. LTD., 23, GREAT QUEEN ST., LONDON, W.C.2

8TH APRIL 1948 VOL. 98 NO. 2446

SMOKE RINGS

Our Cover Picture

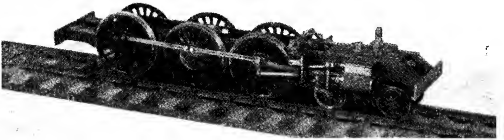
● THE DELIGHTFUL picture shown on our cover this week is of a model by Mr. C. A. Morris, of Bourton-on-the-Water, Gloucester. Mr. Morris has hit upon the rather novel idea of constructing in his garden this model of the village in which he lives. We cannot say which of the model houses to be seen in this picture is Mr. Morris's, but if we knew which it was, we would expect to see in the garden a model of the model village seen on our cover—and so on *ad infinitum*!

Interchange of Locomotives

● IT WOULD appear that, during the coming summer, locomotive enthusiasts in many parts of Britain will be provided with some interesting entertainment on a scale never witnessed before on our railways. An exchange of locomotives between the regions of the British Railways is being arranged to start on Monday, April 19th, in order to obtain information on which to base plans for future standardisation. The locomotives to be exchanged will be express passenger, mixed traffic, and freight engines. These engines will be worked in the normal services over selected routes. Dynamometer cars, in which speeds and other essential data are recorded, will be attached to these trains, which will be made up to agreed weights so as to afford comparative information. The locomotives will all use the same grade of coal when working on the same test and the engines will be manned by the enginemen who normally work them in their home region. The tests will be spread over a period of about four months. The express passenger locomotive tests will be completed in about nine weeks. The mixed traffic locomotive tests will start in the fifth week and extend until the twelfth week. These tests, it is hoped, will provide all necessary information to enable the locomotive engineers of British Railways to decide on the most satisfactory and economical features of the locomotives for the various purposes for which they are required. The results of these tests should enable a very considerable reduction to be made in the number of types built in future, with substantial consequent economy. The selected classes of locomotives include: L.N.E., L.M.S. and S.R. Pacifics; L.M.S. "Royal Scot" and G.W. "King" 4-6-0's; Mixed-traffic 4-6-2 and 4-6-0 types and 2-10-0 and 2-8-0 heavy freight engines. It is interesting to learn that Southern locomotives operating services over routes where water pick-up facilities exist will be fitted with L.M.S. tenders provided with the necessary equipment.

A Miniature "Claughton"

● WE HAVE published in *Model Ships and Power Boats*, some account of the boat-building activities of Mr. H. A. Cox, the article being the outcome of a request that Mr. Cox should publish some of the story of his model making experiences. Among the material he submitted was a photograph and a brief reference to a minature locomotive he is making, and the photograph is reproduced herewith. The little engine, when completed, will be a "O"-gauge 4-cylinder 4-6-0 based on the L.M.S.R. "Claughton" class; and the chief interest is that, in spite of the small scale, the chassis is almost exactly correct to the prototype. Moreover, it will be operated by steam! The boiler is in hand, and though it is rather oversize, even for a rebuilt Claughton, it will be a proper loco.-type generator. Concerning the chassis seen in the photograph, Mr. Cox writes :—"I expect I am not the only one who has got an enormous thrill out of putting a lot of bits and pieces together and, giving them the breath of life out of a tyre-pump, seeing the wheels go round at an astonishing rate! I was never so surprised in my life, but they did; and you can notch up the tiny die-block practically to the middle of the quadrant and still she buzzes away! All very comforting. The valve-motion was a very interesting job, I like fiddling with these tiny things—there is only 0.08 in. between the two holes in the top of the combination-lever. The most tricky part of it was drilling the holes through return-crank and crank-pin, but I did it satisfactorily by holding the whole thing in a jig in a small machine-vice on the vertical slide in the lathe."



The chassis of an "O" gauge L.N.W.R. "Claughton" model by H. A. Cox

The Oldest Model Yacht Club

● IN OUR issue for March 11th we referred to the Tynemouth Model Yacht Club which was founded in 1893. This has produced a letter from Mr. W. E. Whitehead of Bedford who informs us that the Highgate Model Yacht Club was founded in 1853. This club still sails on the same water in Parliament Hill Fields on Hampstead Heath. In a few years they will, we trust, celebrate their centenary. This is something of a record, and we would be interested to hear from any of our readers who can tell us of an even older club.

An Old-time Lancashire Engine Room

● MR. BEN H. WAINWRIGHT who has spent a life-time among the mill engines of Lancashire and Cheshire sends me the following little extract from his store of memories :—"The article in the February 5th issue of THE MODEL ENGINEER brought to mind one of the first jobs I was sent to nearly sixty years ago. I was sent with one of our engineers to indicate some beam engines at a local mill; they had ten beam engines and four horizontal, so it was a tidy job. My duty was to hold the string while he changed the cards. The floor Mr. Woodall refers to was generally called the packing stage, and was a floor, often of stone flags, where the engineer stood whilst he packed the gland of the piston-rod. Metallic packings were unknown then and the lubrication, more often than not, was tallow which was fed into a large brass tallow cup. This tallow was kept on the cylinder cover to keep it melted. I should say from the photograph that the engine had metallic packings and a modern lubricating system. The upper chamber of the engine house was called the beam chamber and often had a large crab at each end for carrying out repairs All these things are of the past, and we did not have the lust for speed, which is, today, such a feature of life. The engines moved at a leisurely pace and the man also, but work was got through and was a job well done, as the life of these engines is a proof."

A Forthcoming Plymouth Show

● THE PLYMOUTH SOCIETY is planning to follow up the success of its 1947 exhibition with another show in May next from the 10th to the 22nd. The Exhibition Secretary is Mr. J. W. Moyse, 5, Evelyn Place, North Road, and in order to introduce novelty and variety in the display he would be glad to hear from any local firms or enthusiasts who can kindly loan suitable exhibits. Last year's show was attended by over 24,000 visitors and it is hoped that a similar success may attend this year's venture.

Percival Marshall

An Old Friend Returns

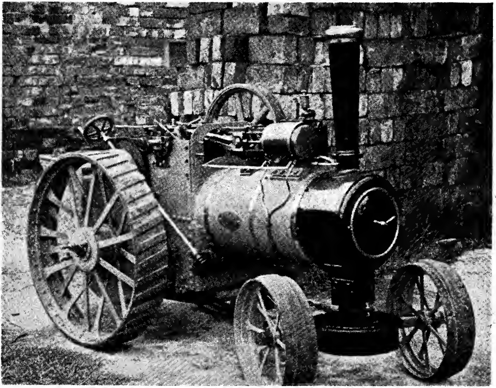
by George W. Eves

IN February, 1922, a very excited boy came to London for an occasion which he will long remember; for, later in the day, he was to drive a big model traction engine round Vincent Square, towing behind it a greengrocer's van, filled with smaller boys. The engine-driver was none other than myself, and what with being filmed and photographed, and spoken to by the late Mr. Don, I was proud of myself and my two elder brothers.

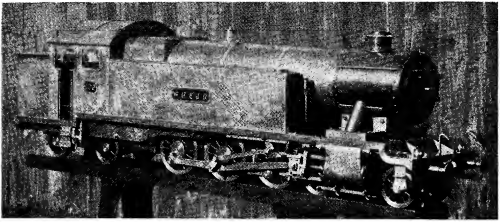
Since then, much has happened. Our traction engine has given pleasure to many an interested caller, and to us much more. One man alone tried to ruin our handiwork; he a German bomb-aimer, and in response to a frantic phone call, I arrived at our country workshop to find our pride and joy standing in a bed of scorched cabbages with a bit of lino flung over it to keep out the drizzle, which made the shambles around it seem far worse. Luckily, there were no personal injuries.

With the war ended, there was time to steam up, when the long, idle years of depredation made themselves apparent. A new boiler was required. Then followed both letters and visits to Gillingham, and in the fullness of time, our worthy friend, Mr. Goodhand, lived up to his name; for the new boiler was an exact replica of the old one for all the original gearing and motion work to be refitted. My eldest brother, Arthur, did all this alone; a formidable task, even when all equipment is available. The steaming and steam-raising capabilities of the new boiler are remarkable. But the old lady hasn't quite got the sharp exhaust-beat that was the hall-mark of every Fowler engine; hence, I understand, some modifications are in progress.

Recently, I took this latest picture, and the differently situated check-valve and the cylinder drains are the only noticeable alterations to the picture which hangs before me, of myself driving her round Vincent Square, way back in 1922.



Some of our older readers will possibly remember the above engine being driven around Vincent Square, S.W., on the occasion of the "M.E." exhibition in 1922.



An ambitious first attempt is successfully completed

A "Halton Tank"

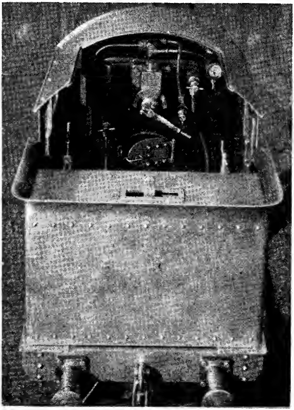
by J. H. Westwood

IT was two and a half years ago when I began work on the "Halton Tank" locomotive; at that time I had never had any previous experience of model engine work, and had a very limited knowledge of the principles of steam traction.

Before discussing the design and construction problems encountered, here are a few general particulars :—

Gauge — 5 in., Type — 4-6-4, cylinder bore — 1½ in., stroke — 2¼ in., weight — 3 cwt. approx., length — 4 ft. 6 in. approx., normal working pressure —85 lb. per sq. in.

Such blueprints and castings as were available were purchased from Messrs. Henry Greenly.



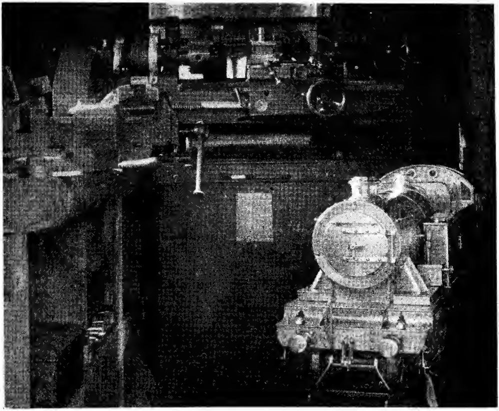
The only castings obtainable were of the wheels and cylinders; all other parts have been machined from solid bar.

The boiler itself is of 5/32 in. × 6 in. diameter copper tube, and contains twelve ⅝-in. diameter flue tubes and a 1-in. diameter superheating tube. The lagging was of 1/32-in. thick copper sheet with brass lagging-straps. The chimney was turned and beaten from solid copper, and a brass ring was afterwards shrunk on the top. The safety-valve cover was also turned and beaten from solid brass.

The cab, tanks and side platforms are of brass, and the name- and number-plates were produced by cutting

out the letters and surround from 1/32-in. sheet brass and sweating these to the base panel attached to the cab and tank. In case the nameplate provokes curiosity, may I assure readers that this is entirely a family affair. It was not possible to purchase the beading for the tanks and cab, so I made this by winding $\frac{3}{16}$ in. diameter copper wire on to a mandrel, and machining

suitable track was available, the only trials I have been able to make have been a series of non-stop eight-hour tests with the engine free-running. In addition to this, I experimented by placing it against an obstruction when its power was amply proved by the amount of ash drawn from the firebox and thrown out of the chimney, and the amount of wheel spin developed.



A front end view of the "Halton Tank" locomotive, and a corner of the workshop in which it was made

it down to half-round section. All smokebox door fittings, buffers and screw-couplings are of stainless steel.

Valves were of the piston type, $\frac{7}{8}$ in. diameter, fitted with relief-valves for trapped water, and blow-down drain-cocks. The valve-gear is the familiar Walschaerts, the mechanical lubricator being driven from the expansion-link. This lubricator is of the usual oscillating type, and feeds direct into each steam pipe. The hand-pump fitted in the rear tank is of the double plunger type, and it is only necessary to use this when first filling the boiler, as the injector is quite capable of adequately feeding the boiler afterwards.

The backplate fittings are of the usual type. and comprise pressure-gauge, water-gauge, whistle-turret, injector-valve and regulator, the latter being partly my own design. A snifting-valve is fitted beneath the smokebox.

As I am not a member of any club, and as no

Apart from the helpful articles given in THE MODEL ENGINEER by "L.B.S.C.," my only source of information was continual visits to Snow Hill Station at Birmingham, armed with a sketch book and rule.

All the work was done with a $3\frac{1}{2}$-in. Mellor lathe and a hand bench-drill, in the very limited floor space of a shed 5 ft. × 8 ft. A check on my time throughout has proved that a total of 3,000 hours have been spent on the work.

The photographs are by Mr. J. Cockin, of Old Hill, and show the engine unpainted. While I may consider having it sprayed professionally at a later date, I feel at present that the burnished metal looks very workmanlike, and that my own attempts with a brush would do nothing to improve this.

After suitable trials have been made, I propose to strip down the engine and fit steam brakes on to her.

*Swords into Ploughshares

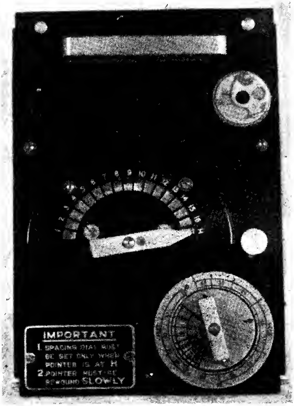
Hints on the adaptation of "surplus" war material for model engineering or utility purposes

Gearing and Mechanism

by "Artificer"

ANOTHER instrument which contains a very ingenious time-control mechanism is the bomb timing distributor, which, as its name implies, was used to control the dropping of a number of bombs in regular sequence over a definite but adjustable period of time. As the bombs were released by electrical means, the instrument contains certain electrical components, but in other respects it is a purely mechanical device, and the motive-power for operating it is obtained from a spring. In contrast to the electrically-driven escapement of the camera control unit, described in the previous article, which can be adapted to continuous operation over any required period of time, this mechanism has definite limitations in this respect; its normal time range is from, approximately, half to 6 sec., though this could be modified to some extent by adjustment or minor alterations of the internal gearing.

The selector switch is visible on the panel, and consists of a number of radial contact segments arranged in a semi-circle around the pivot of the contact arm and numbered from 1 to 16. A time-setting dial is provided, marked in 1/10 sec., and this controls the time taken by the contact arm in traversing the set of the selector contacts. Other fittings on the panel include a press button to unlock the mechanism, both for setting and for releasing the bombs, and an indicator lamp fitting, with a dimming screen, which can be brought into use for night flying.



Front view of distributor panel, showing selector, push button and timing dial.

Setting is carried out by pressing the button and turning the contact-arm against the tension of the driving spring, as far as it will go to the right, where it is held when the button is released; the lamp then indicates that the instrument is set and ready for use. Upon pressing the button again, the contact arm is released and travels over the contacts at a rate determined by the setting of the time control, closing each of the contacts in turn, and thereby releasing bombs in regular and accurately timed order.

The timing mechanism in this case embodies a small centrifugal governor of the type in which the weights actuate a friction brake, as in a gramophone, but it normally functions at a fixed speed and its construction is practically identical with the governor of a telephone dial. Its function differs from that of the latter, however, in controlling the action of a set of contacts, instead of actuating the same contacts a specified number of times. Moreover, the gearing which drives the governor is variable, so that although the latter runs at a constant speed, the time taken for the

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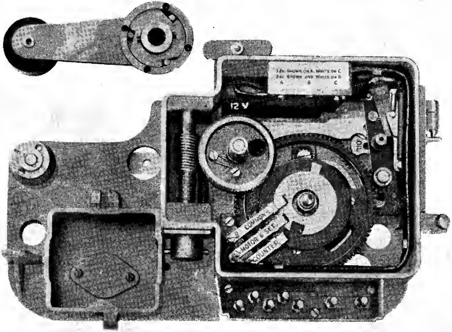
**Continued from page 321, "M.E.," March 25, 1948.*

operation of the set of contacts is controllable.

An ingenious form of variable friction-gear is employed to effect this adjustment of ratio, comprising two discs running on adjacent parallel shafts, so as to overlap each other, centre to periphery. Between them is an arm which guides a ball or roller, which makes contact with both discs, and is kept pressed firmly against them by endwise loading of the shafts. Rotation of one disc is thus transmitted, through the roller, to the second disc by frictional contact, at a speed determined by the radial position of the roller. If the latter is near the centre of the driving disc, and near the periphery of the driven disc, the latter will run at reduced speed, and vice versa. At a position midway between the centre and the periphery of each disc, the speed of driving and driven shafts will be equal. This does not take into account the effect of any slip which may take place between the discs and the roller, and it is fairly obvious that the torque which can be transmitted by such a device, without serious slip taking place, is strictly limited, and that its mechanical efficiency is also low, owing to friction and heavy end thrusts. It should not be regarded, therefore, as the ideal variable-ratio drive, but it is quite adequate and satisfactory for its intended purpose. Mechanism working on similar principles has been extensively used on integrating instruments, and another well-known application is in the feed-gear of coil-winding machines.

The complete instrument as described above could be used for "process timing" on similar lines to those described for the camera-control unit, its limitations in respect of time extension being more rigid than the latter, but it has the advantage of being able to control any number of electrical circuits, up to the maximum number of contacts on the dial, and could thus be used for carrying out several operations in sequence. Examples of this kind of application would be, for instance, the switching on of lamps to change colour, or spell out letters in an advertising display device, or the successive operation of manoeuvring controls in a model boat.

When stripped down, the time-control unit could be used separately, or with the governor removed, its variable gear could be employed for any desired purpose within its torque capacity. The panel, with its selector switch, could be adapted to use as a power distributor unit, or selective control of resistance, capacity, or number of battery cells in circuit. Devices of this nature are in constant demand in the electrical laboratory, demonstration room or classroom, and are useful in electrical test equipment of all kinds.



Camera gearbox with cover removed, and crank for winding and setting by hand (The power drive is applied through flexible shafting, to the worm reduction gear)

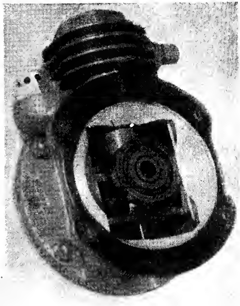
Driving motor for R.A.F. aircraft reconnaissance camera (Aero Spares Co.)

Shutter Motors

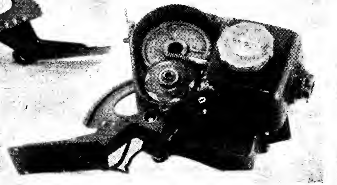
Many of the auxiliary control devices on modern aircraft are electrically-operated, and small motor and gear units designed for such purposes as opening ventilating shutters, and retracting external fittings such as spot or signal lamps, are often encountered on the "surplus" market. One such device recently inspected, and illustrated herewith, embodies a 12-volt reversible motor, with a magnetic brake, and driving, through a combination of worm and spur gearing, a quadrant gear, presumably designed for connection or direct attachment to the particular control device. Incorporated in the mechanism is a set of contacts for limiting the travel of the quadrant in either direction, and also an overload clutch.

Apart from the motor itself, which in this case has a particularly interesting feature of design—namely, the use of two separate field windings for convenience in reversing—interest in this device centres mainly in the gearing, which is of a type likely to be adaptable to many purposes in model engineering. Either the complete unit, or the gear-train only, could be used for operating a drawbridge, swingbridge, or level-crossing gates in a model railway, or for comparable duties in an automatic model of a transporter or excavator. More prosaic utility applications would be the remote-control of a ventilator or conservatory window, or the aperature of an observatory roof, all of which often involve problems when purely mechanical means of operation are attempted.

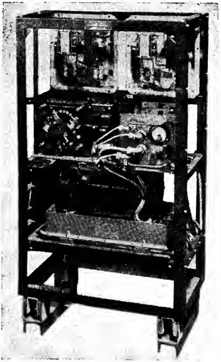
The standard form of aircraft camera, adopted



B.T.H. Air Compressor (D. R. Welch & Co. Ltd.)



Two views of shutter or flap control unit, showing motor gearing and contacts (H. Franks)

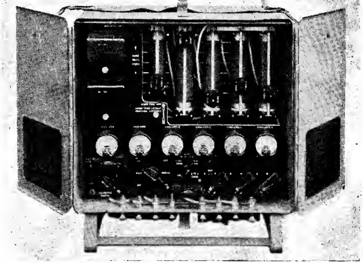


Power supply unit, with alternator, controller and rectifiers (Gamages)

by the R.A.F. for aerial reconnaissance purposes during the war, was designed to take a photograph 5 in. × 5 in. on roll film, and apart from its size, was generally similar in working principles to the modern high-class miniature camera, with which many amateurs are familiar. It had many extra fittings and refinements, however, including such things as built-in lens hoods and filters, also heater elements to prevent the misting or icing up of lenses; it also had automatic mechanical means of winding the film and setting the focal-plane shutter prior to exposure.

The gearbox for this purpose, attached to the camera itself, should not be confused with the camera control unit, already described, which operates at a distance from the camera. The two are, however, normally complementary and interdependent, though the camera, with its gearbox, can be manually operated, without the need or any control-unit or driving motor. A number of camera gearboxes are now being offered for sale on the "surplus" market, so it may be useful to describe them for the benefit of readers who are interested.

The essential parts of the gearbox comprise a driving member, which is normally operated through worm reduction gearing from an external motor, but is sometimes equipped with a crank handle for hand operation. This member embodies an interrupted spur-gear which meshes intermittently with pinions driving, respectively, the film winding rollers and the rollers of the focal-plane shutter, both these components being parts of the camera itself, not the gearbox, which is a detachable unit. A contact-plate attached to the shaft of the driving member, in conjunction with contact brushes, control the driving motor, and electrically-operated exposure counter, incorporating also means of preventing the shutter being released before the camera is properly set. The shutter release lever, which may be operated either by hand or electrically, through a small solenoid, actuates by lifting a pawl which normally engages the teeth of the shutter blind pinion, so that the latter forms a ratchet wheel. As the blind is under tension from a return spring, lifting the pawl allows it to fly back to its starting point, the slit in the shutter forming the exposure aperture. While the shutter is being rewound for setting, a second blind, known as the "capping" blind, is wound with it, and covers the slit in the main blind to prevent exposure of the film during this period; after which the capping blind is allowed to return alone, leaving the main blind set.



Multi-circuit charging panel with rheostats, meters and cut-outs (Gamages)

The camera gearbox is not, perhaps, readily adaptable to other purposes than that for which it was initially designed, but it contains several very useful components, such as the gears and pinions, cams, levers, contacts and solenoid, which could be used for other purposes in model engineering.

Camera Motors

The motor driving the camera gearbox is a separate unit, mounted near the camera and driving it through a flexible shaft. As many of these motors are now on the market, and in conjunction with the flexible shaft, suggest interesting possibilities for driving hand tools and milling attachments in the workshop, several readers have asked for advice as to the practicability of such schemes. These motors should not be confused with the small cinematograph and gun camera motors previously described. They are designed to run on 12 or 24 volts d.c., but will operate on a.c. of somewhat greater voltage in each case, and are extremely powerful for their size. For the short periods of use likely to be required of them, it would be practicable to run them from car batteries, and readers who have cars lying idle may find that keeping the batteries in use is better for them than letting them remain idle, so long as they are kept charged by means of a trickle charger. For working on a.c., a transformer is recommended, preferably with secondary tappings, so that the most suitable voltage for the speed and duty required can be selected.

The flexible shaft casings for these motors are connected by means of bayonet joints, which may possibly tend to become disconnected under heavy-torque conditions, and it may be found advisable to provide some means of locking them. It is, of course, necessary to provide a hand-piece or spindle head for driving the rotary tools, having means of coupling up the casing, and also the internal flexible shaft.

It will be noted that discussion has again returned to the subject of electric motors, and if any apology for this is thought necessary, it may be mentioned that most of the queries and comments from readers concern this subject in some form or another. When these articles were first planned, it was intended to keep the various subjects all neatly classified and dealt with in regular order, but it was soon found that this was impracticable, or at least hardly conducive to serving the requirements of readers. Apart from the desirability of arranging the subjects to suit the goods which are discovered or brought to the notice of the writer, it has been realised that many of these, though available in large quantities when first offered for disposal, may be snapped up very quickly, and unless dealt with immediately, they may be out of date by the time they are described in these pages. It will, therefore, be necessary to hop from one subject to another in the future, without regard to whether it belongs to a definite class of apparatus or not.

Air Compressors

Many of these are now on the market, a typical example being the B.T.H. compressor, which was fitted on the camshaft casing or auxiliary gearbox of certain types of aircraft engines, its purpose being to supply air at high pressure to pneumatic control devices. A compressor of this type, submitted by Messrs. D. R. Welch & Co. Ltd., Putney, is shown herewith. It has a bore of 1 in., and a stroke of $1\frac{1}{8}$ in., and is capable of working efficiently at speeds up to 1,200 r.p.m., with an output of 0.368 cu. ft. per min., at a pressure of 300-500 lb. per sq. in.

The crankshaft of this machine runs on two ballraces, and operates the piston through a slide-crank with a split bronze die block, adequate bearing surface being provided on all sliding surfaces; lubrication by splash is practicable, but for long continuous running at high speed, some means of replenishing or constantly feeding oil to the crankcase is desirable.

A somewhat larger capacity compressor is offered by Gamages, and this type is noteworthy for its extremely high quality of workmanship and finish. It suffers, however, from the disadvantage of having no external drive shaft, being intended to drive off the projecting end of a splined shaft, and it would be necessary to equip it with a specially-made shaft and an external bearing for normal use, unless it could be spigot-mounted on an engine, electric motor or gearbox.

With either of these compressors, it would be desirable to fit a fairly heavy flywheel, especially if gearing or belt-drive is to be used. In order to adapt them to work at lower pressures than those for which they were designed, lighter delivery valve springs are advisable. With suitable modification, they are very serviceable for such purposes as paint spraying, air service to working models, and raising steam in model locomotives.

Electric Power Distribution Equipment

Portable generators and their equipment are offered by many firms; it is not proposed to say much about the generating plant itself, as its uses are fairly obvious, but a word or two about accessories, such as switchboards and distribution equipment may be of general interest.

Switchboards for electric accumulator charging sets, fitted to vertical steel stands, are offered by the Aero Spares Co.; these have some of the instruments removed, but include various switches, one ammeter and one variable resistance, on a bakelite panel, and are very low in cost. Messrs. Gamages have some complete power distribution boards, with ironclad switches, regulating resistances, meters, fuses and plug sockets, which could be used for the main switchboard of a country house lighting installation. They also have a number of much larger units, totally enclosed in metal cabinets, with many high-class accessories, including moving-coil voltmeters and ammeters, rectifiers, rheostats, etc., and are sold at prices which certainly would not cover the initial cost of the framework, apart from that of its internal components.

(To be continued)

"MAID OF KENT"

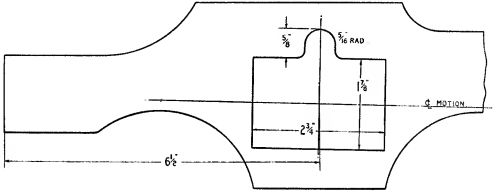
Alternative Outside Cylinders

by "L.B.S.C."

IN fulfilment of my promise to describe and illustrate a pair of outside cylinders suitable for the 5-in. gauge passenger engine, here is the needful. It was a bit of a job to scheme out a satisfactory arrangement, and at the same time keep to the general dimensions given for the inside-cylinder job, and utilise the inside valve-gear. It seemed too much of a good thing, in a manner of speaking, to redesign the whole issue and use an outside valve-gear; also, the majority of the builders requiring the outside cylinders, want to finish off the engine as one of the L.M.S. "Crimson Ramblers" (the Midland compound type) and they have inside valve-gear. I also considered the G.W.R. arrangement, with valves on top of the cylinders, set in toward the frame, and the spindles operated by a rocking-shaft with pendulum levers, actuated by the inside valve-gear, same as Swindon practice; but this would have necessitated alterations to the running boards and so altered the characteristics of the engine that she would have needed a G.W.R. taper boiler and accessories to suit; otherwise she would have looked too much of a hybrid. Anyway, taking things "by and large," I fancy the cylinders shown will fill the bill nicely. They are the same bore and stroke, with ports and valves exactly the same as the inside cylinders, so that the valve-gear will do without alteration. The running-boards won't need alteration either, and the steam and exhaust connections are easily made, since the pipe arrangements inside the smokebox remain unchanged.

Hole in Frame

As the steam-chest goes through the frame, a hole will be needed, and if you have your frames erected by screws and angles, the easiest way to cut the holes would be to take them apart again and temporarily bolt the frames back to back. The hole is easily marked out. I have already explained how to get the centre-line of motion. On this, at $6\frac{1}{2}$ in. from the front end of frame, scribe a line intersecting it at right-angles; and taking the intersection as your "base" set out the rectangle shown, $2\frac{3}{4}$ in. long and $1\frac{7}{8}$ in. wide. The archway at the top is to let the exhaust pipe through. Drill a series of $\frac{1}{8}$-in. holes all around the rectangle, inside the marked lines, break out the pieces, clean up to outline with a file, and part and re-erect the frames.



Hole in frame required for outside cylinder

If a brazed-up or Sifbronzed frame assembly has already been made, mark out separately on each side. A slight variation in cylinder location doesn't matter as it doesn't affect the working, and nobody can see both sides of the engine at once. The openings in each frame can easily be cut separately without interfering with anything else.

Cylinder Castings

The cylinder castings are similar to those specified for "Iris," "Juliet" and similar $3\frac{1}{2}$-in. gauge engines, simply enlarged to suit the "Maid of Kent." The centre-line of the bores will stand $1\frac{1}{4}$ in. away from the frame. Two flanges are provided, at top and bottom of the steam-chest, for attachment of cylinders to frame, the upper one having a semicircular segment cut out of the centre, to allow the exhaust-pipe to pass. The covers are smaller than those on the inside cylinders.

The boring operation can either be carried out on the face plate, or with the casting mounted on the saddle, as described for the inside cylinders. In the former case, the casting is set up in the same manner as described for the inside cylinder-block, but in this case you'll need a clamping-plate with a hole in the middle (pipe flange would do; large ones are readily obtainable)

the hole being slightly larger than the finished cylinder bore. Also, be very careful, when arranging your packing-pieces between faceplate and cylinder, to set the packing-pieces so that the boring tool won't hit them when it comes through.

For boring with a bar, mount the cylinder in a similar fashion to the method described for the inside cylinder casting, clamping it down with a bar across its back, and a bolt through each end of the bar. Then go ahead and bore the cylinder, same as I described in the issue of February 26th last, in which both methods were given, so I need not waste space by repeating them here. The end flanges are faced off with the cylinder mounted on a stub mandrel. The port-face may be machined as described in the issue mentioned above, but there are two extra little bits to machine, viz. the two flanges for attaching cylinder to frame. If I were doing the job myself (I hope to, if I can scrape up the time at a later date) I should mill the port-face and flanges at one setting. The casting would be clamped, port-face up, in the machine-vice on the table of my horizontal milling-machine. A slabbing cutter would make short work of the port-face; and I should then put a 3-in. end-and-face circular cutter on the arbor, set the work so that the cutter would take out all surplus metal at each side at a single cut, and do both flanges without shifting the vertical adjustment of the table. This would ensure port-face and both flanges being all in line. The port-face should be $1\frac{3}{8}$ in. from the cylinder bore centre-line, and the contact side of the two flanges $\frac{1}{4}$ in. below the port-face (see illustrations).

The rest of the work on the outside cylinders is carried out in exactly the same way as already described for the inside set, except for trivial differences. After cutting the ports, make a centre-pop on the casting over the exhaust port, midway between the two cover flanges, and $\frac{3}{8}$ in. away from the upper fixing flange. Drill from this point into the exhaust port, on the slant, with a $\frac{3}{8}$-in. drill (see port section). When the cylinders are erected, and the exhaust pipes fitted, a flange carrying one end of the cross-pipe will be screwed down over this hole, as shown by dotted lines in the plan view. When drilling the passageways between port and bore, don't forget to leave room for a screw in the middle, or you'll be having the cover joint blowing out at this point.

As a variation, and to please Inspector Meticulous, as the guide-bars show, I am specifying the usual flat seat attachment for them, instead of the spigot fitting specified for the inside bars. The seatings on the back covers can easily be milled in the lathe, same as described for axle-boxes. Clamp under the slide-rest tool-holder at correct height, and traverse across an end-mill or slot-drill, not less than $\frac{3}{8}$ in. diameter, held in the three-jaw.

The steam-chest having only one boss, this can be turned, and the ends faced off, between centres. The boss is drilled, opened out and tapped for the gland, with the drills and taps in the three-jaw, the steam-chest being supported by the tailstock centre, with the centre-point in the centre-mark on the opposite end of the steam-chest. The contact faces are machined off with the casting held in the four-jaw, same as the inside one. The cover is fitted the same way. At $\frac{5}{8}$ in. from the plain end, on the centre-line of the steam-chest wall, drill a $\frac{5}{16}$-in. hole for steam inlet; and when attaching the steam-chest to the cylinder, see that this hole is at the top. Maybe you will think that an unnecessary warning; well, don't you believe it! I've seen and heard of good folk doing all sorts of absent-minded things. Have you ever silver-soldered a union cone on a pipe, and forgot to put the nut on first? I once saw a plumber make a lovely wiped joint between a lead pipe and a union tail or lining, as they call them, but he inadvertently left the nut on the lead pipe, and found it wouldn't go over his artistic bit of plumbing. At that moment, I discovered that railwaymen aren't the only users of a particular brand of Esperanto!

Assembly and Erection

Steam-chest cover, piston and rod, piston and spindle glands, slide-valve, buckle, and valve-spindle, are all made and fitted in the manner described for the inside cylinders, the dimensions of the latter items being precisely the same. Before putting the bits temporarily together (wait until you have made and fitted the guide-bars, crossheads, yokes and connecting-rods before assembling "for keeps" with packed pistons, glands and cover joints), drill the holes for the fixing-screws in the flanges, and file out the clearance in the upper fixing flange for the exhaust pipe. These holes are shown in the illustration of the port-face. File off any burrs, so that the flanges fit snugly against the frame.

To erect the cylinders, all you have to do, is to remove the steam-chest complete with valve; poke the port-face through the hole in the frame, which it should fit nicely without shake. Clamp temporarily in position, and put the No. 21 drill through all the holes in the flanges, carrying on right through the frame. The cylinders can then be attached, when completely finished, by 5/32-in. or 3-B.A. bolts through flange and frame, the nuts being inside or out, just as you fancy. The above ought to keep outside-cylinder builders busy whilst I make a drawing of suitable guide-bars, brackets, crossheads and connecting-rods.

A Little Railway Carries On

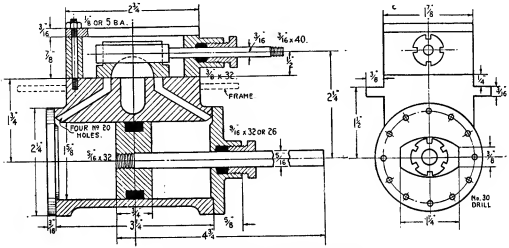
I expect by the time these notes appear in print, readers will have forgotten nearly all about the end-of-February blizzard; but at time of writing, the snow has only just disappeared from the piece of ground where my little railway is situated. In passing, the line was still in operation whilst sections of its full-sized relatives were put out of action by Jack Frost & Co. When the snow stopped falling on the morning of February 23rd, there was a wall of snow the full width of the sleepers, and over a foot high, completely covering the railway; and the old L.B. & S.C.R. signal looked something like a kiddies' snow-man with one arm outstretched, the only part not being literally snowed under being the lamp, which was still burning, and had kept warm. As I had to dig a path to get to the shed where I keep the gasoline cart, I thought it wouldn't be a bad idea to clear the line as well, whilst on the job, so I ran the garden shovel around the whole 250 ft., snowplough fashion. Another run around

with the bass broom completely cleared the rails, and opened the line for traffic. I took one of the engines out, and had a rather "parky" journey, but the locomotive never troubled a scrap, blowing off as merrily as ever, the only noticeable difference in the running being that the exhaust came out of the chimney in a white cloud, despite the very high superheat temperature. She slipped two or three times when first starting on the icy rails, but after about three laps, my weight on the car shifted all traces of ice from the railheads, and after that everything was all right. I got tired of it before the engine did!

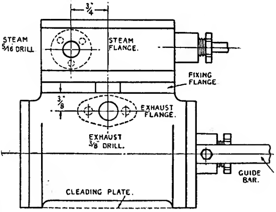
wonderful if an engine made enough steam to pull its own tender in a moderate breeze!

"The Absolute Minimum"

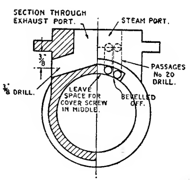
Much of the recent correspondence that has cascaded on to the doormat of our hacienda has come from new readers and beginners, and maybe a word or two right here, might prevent others writing in similar strain, and save both my time and their own. Now last week, time of writing, a letter came along, the writer of which stated that he was an entirely new reader, without mechanical experience; but he had read these



Section and end view of outside cylinder



Plan of outside cylinder



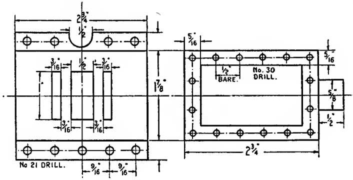
Steam and exhaust passages

Summer sun, winter frost and snow, squalls, gales, hail, rain, even thunder and lightning, the tiny locomotives have done their job of work in the same way as their big sisters, in open defiance of the elements. How different from the days, not so very long past, when it was thought

notes and got a touch of the locomotive fever in consequence. He thought he could build an engine by following the notes, and wanted to know the absolute minimum of equipment necessary for doing the job, also what locomotive would I recommend for him as a "maiden

effort." Incidentally, he forgot the return ticket, a common failing among those writing for the first time—a nod is as good as a wink to a blind horse! He also said that about £20 was the limit of expenditure to which he was prepared to go.

Now I'm not holding him up to ridicule; far be from me any such intention. The query was quite sincere, and made in all good faith, with the best of intentions. I am sorry to pour any cold water on his hopes, but at present-day prices and under present conditions, the sum he names would be little more than a drop in the ocean. If he started to equip a workshop, he needs a lathe, tools for same, drilling-machine, bench-vice, screwing-tackle, files, hand-brace and drills, umpteen kinds of hand tools such as hammers, pliers, snips, screwdrivers, hacksaw, measuring instruments and so on, not to mention brazing and soldering equipment. A glance through any tool-dealer's catalogue would show him how far his £20 would go nowadays!



Portface and steam-chest

About the simplest job he could start on, would be the $3\frac{1}{2}$-in. gauge 0-4-0 tank engine "Juliet," which I described some little time ago; yes, he wants an engine to pull him and a couple of kiddies. The castings and material for this, purchased even from the most reasonable of present-day suppliers, would make a big hole in his cash. If he thought to dispense with the lathe and drilling-machine, and just rig up a bench in the kitchen, with a vice and a few hand tools, he would be no better off, because the price of the finished parts, especially cylinders and boiler, purchased finished ready for assembly, would wipe out his assets.

It is a virtual impossibility to make a list of the *minimum* equipment necessary for building a locomotive "from scratch," that is from raw castings and material; so much depends on the person who wants to undertake the job. I always remember a glowing testimonial printed in Sutcliffe's catalogue of half-a-century and more ago, to the effect that the writer had purchased a set of castings, and made up a stationary engine from them, merely using files and emery-cloth. I'd dearly loved to have seen how he "bored" the cylinder! Not that I doubt it, mind you; schoolboys in those days were enthusiastic, and with no movies, radio, or modern amusements, they had to find some way of spending their leisure. Probably the poor kid was just another Curly, and spent hours and hours labouring away with his files and emery-cloth, in the hope of eventually seeing the flywheel spin under steam. I hope it did! He certainly used the minimum of equipment, anyway; but maybe another purchaser of an exactly similar set of castings, might have considered that the minimum of equipment necessary to make up the engine, was the lathe and tools mentioned above.

Here is what I humbly suggest is a good tip for any beginner who wants to go in for locomotive building and is hazy as to what he needs in the way of tools and other impedimenta. Get a pencil and paper, or a notebook, and whenever I describe how to do a job, in full detail, make a note of the tools mentioned. By the time our new friend is ready to make a start, and has decided on the size and type of locomotive, he should have quite a comprehensive list. If he wants to start right away, rig up a bench, fix a good vice on it, purchase a hand-brace and a set of drills from $\frac{1}{16}$ in. to $\frac{1}{2}$ in., a few files of assorted sizes, a hacksaw, a pair of pliers, a hammer, centre punch, steel rule, and a pair of dividers. They will enable him to cut out and erect the frames, and fit the hornblocks of any engine I have described.

Another "absolute minimum" which is always cropping up, is the minimum radius curve required for a given class of engine. This is an entirely wrong idea altogether; it is the worst thing one can do, to set any engine continually grinding its way around "minimum radius" curves. A recent correspondent wanted to know if the "Maid of Kent" would go around a 10-ft. radius curve in a suburban back garden. I told him yes, if he made the wheel treads about $1\frac{1}{2}$ in. wide, and allowed about 1 in. extra on the gauge of the curve! If anybody wants to set up a continuous track in a back garden of average width, that's quite O.K. and a good idea. You can't beat a "non-stop" for enjoying a bit of real engine-driving. The only thing is that the locomotive must be made to suit the curve. Now our friend above-mentioned, should adopt a narrower gauge; if he is keen on a 4-4-0 such as the "Maid of Kent," he would have to adopt $2\frac{1}{2}$-in. gauge, but if he could make do with a tank engine like "Juliet," he could make his line $3\frac{1}{2}$-in. gauge. He can, of course, ride on either size; and in $2\frac{1}{2}$-in. gauge he could build a powerful engine, such as "Austere Ada," which would not only negotiate the 10-ft. radius, but would pull a very heavy load around it, and not be too expensive to build.

Finally, in answer to several more experienced correspondents, the curves required by the 5-in. gauge engines "Maid of Kent" and "Minx," should not be less than 35-ft. radius, for safe and fairly easy running.

A Small Draw-bench

by "The Leveret"

DURING the war, I made some experiments with a small draw-bench. It was very crude but worked well, the results being so encouraging as to fully justify the making of a better one. The sketches will make the construction clear, but please do not imagine that this is how I suggest it should be made. I merely indicate what mine looked like after I had finished scrounging bits and pieces—including the mincing-machine handle!

My only excuse for presenting to readers such a crude design is that the persons most likely to require drawn sections in considerable quantities are usually those who have not the means to make anything better; such persons as aircraft, ship, and "tinplate" railway modellers, who rarely possess a lathe or milling machine. Besides, having made the basic principles clear, the draw-bench can be elaborated according to the ideas of the builder. It is worthy of great care, actually, for the more accurate the slide and the more rigid the die the better the product. Also, the smoother the pull applies, the less likelihood there is of ripples and ridges occurring on the resulting sections.

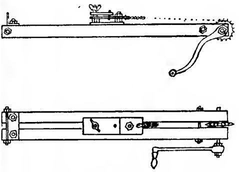


Fig. 1. Plan and elevation of experimental draw-bench

The machine consists of a bed, somewhat similar to a lathe bed, along which a slide can be drawn by a roller chain running over sprockets. At one end of this bed is a die, or provision for quickly fixing one or more of several dies. This part of the machine must be really rigid, and the die at right-angles to the bed or curved, bowed lengths will be produced, which are impossible to straighten satisfactorily. On the slide a clamp is provided and this must be capable of a really vice-like grip, as the resistance of the die is fairly considerable; if the clamp "gives" at all, and a one-sided pull is imparted to the metal strip, curved or distorted work results.

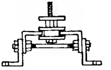


Fig. 2. End elevation

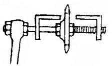


Fig. 3. Winding spindle and sprocket

Complicated sections must be produced in easy stages, a "W" section being first bent at right-angles, then more acutely to a "V," each limb then bent outward and finally brought to the full "W." A die must be made for each change of shape (see Fig. 4). Often, especially with light gauge or ductile material, two dies may be employed at once, producing the finished section, if of fairly simple form, in one operation.

These dies are the most difficult part to make. Not only are they of irregular shape but must be fairly accurate. I am, unfortunately, unable to give any precise instructions, but found the following points very important. The width of the strip must conform exactly to the total length of the opening in the die. It is not necessary to make allowances for increase or decrease of width due to bending, at least I never found it to be. The strip must be of absolutely uniform width. The die should have at least $\frac{1}{4}$ in. of width (thickness) in order to have a "straightening" effect on the metal and to prevent curved pieces. The two halves of the die must be firmly held together so that the edge of the strip cannot penetrate between the two; for this reason, arrange, if it is possible, that the edges of the strip run against a solid end. This, however, requires a very narrow saw which is not easily obtained.

Normally, the width of the slot in the die would be, at any point on its length or breadth, equal to the thickness of the metal strip but this need not necessarily be so. For example, tubes can be produced by a die with simply a round hole. Other sections can be produced by these "open" dies, as I call them, but the results can be uncertain; once having, as a result of experiment, decided upon a suitable form of "open" die, it will produce dozens of uniform pieces, then suddenly produce one "random variation"! At the same time, such dies are very useful. For the production of rounded bends, it is extremely difficult to make the con-

tour of the die at the inner side of the bend to exactly conform to that of the outer but less the gauge of the metal, as it should in theory. But since, for example, a more or less rectangular opening will usually produce good " U " sections, it may not be considered necessary to make a more exact die. In theory also, there should be a die for each gauge of metal but it is unnecessary unless the difference between strip and slot be very great.

The Die Box

On a full-size draw-bench the dies are held in a frame resembling a box without ends, the inner faces of the sides being slotted vertically so that one or more dies can be dropped in, rather after the manner of the removable division of a drawer or tool-box (see Fig. 6).

When starting operations the flat strip is first formed with pliers to as nearly as possible the shape that the die would produce. The die is then put together round it and dropped into the die-box or attached to the machine by any other suitable means. The protruding end is then flattened and fixed in the clamp. This

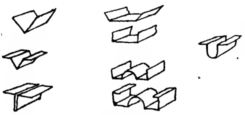


Fig. 4. Drawn sections in various stages of formation

flattened end must be level with the average line of resistance, or the piece will be curved as a result. A few inches are now drawn and the uneven, hand-formed portion cut off and a new grip taken with the clamp. A full length may now be drawn.

The average line of resistance of a particular die may be "remembered" in the form of an anvil-block which may be placed on the bed and used to hammer the strip flat upon, keeping each anvil-block with the die to which it corresponds. It would be possible, and also very desirable, to arrange for each die to have the line of resistance at the same height. This is easier than it sounds, for by making the dies higher than they need be and subsequently removing metal from the base, they may be made to produce straight sections when used with the common anvil-block. This, of course, avoids the need for vertical adjustment of the clamp on the slide.

The Best Form for Strip

By far the best form for the strip is a roll of continuous length, for then, having drawn one length, the section is cut through near the die and a second grip taken with the clamp. Thus, several sections may be produced with one assembly of the die or dies, and there is less waste. It may be obvious, but I will point out that if you require, say, 10-in. lengths, don't draw dozens of 24 in., 12 in. or other odd lengths, or the waste will be considerable. Short pieces can be drawn, however, and I used strips of tinplate carefully cut parallel. The dies in full-size practice are lubricated with tallow, but I used no lubricant whatsoever.

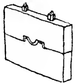


Fig. 5. A suitable design for the die

In the experimental draw-bench, I fitted a magneto sprocket between two nuts on to a bicycle spindle and attached the mincing-machine handle in the same way. Since both threads were right-handed, they locked up solid, the operating handle then being at the right-hand end of the bed which is most convenient. The chain should pass along the underside of the bed and over a second sprocket or a roller, and be attached to the slide. Thus, the slide can be returned to the die and also there is less chance of the chain, which, by the way, is bicycle chain, jumping the teeth of the sprocket. In my case the chain dangled over the edge of the kitchen table with one of the household weights tied on to the end!

The effort required to draw tinplate strips $\frac{5}{8}$ in. wide was very little and easily done with one hand, producing either two 45-deg. angles or one 90-deg. at each drawing. If, of course, the handle drives through reduction gearing there is no limit to the pull available, but I hardly think this will be found necessary.

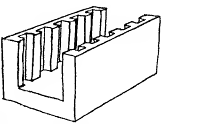


Fig. 6. Type of die box used on full-size machine

By the way, I saw recently some 4-ft. lengths of right-angled steel that a friend had obtained for fencing posts; apparently they were parts of Anderson shelters and obtainable from the local council authorities for eighteenpence each. Two of these would make an ideal bed, being substantial, cheap, and not likely ever to prove too short.

IN THE WORKSHOP

by "Duplex"

8—Index Collars

In former times, when lathes were of simple design and the turner made his measurements and settings with the aid of calipers, rule and a piece of chalk, the mechanic worked to the nearest 1/64 in.; but nowdays, even the modest worker thinks in terms of thousandths of an inch, measured by his micrometer and set by the feed-screws operating the slides of his modern lathe. To enable full advantage to be taken of the accurately fitted machine slides, each should expenditure on these fittings, but fortunately any shortcomings in this respect can quite easily be made good by any who are interested in improving the performance and ease of handling of their lathes.

Should the opportunity arise, those contemplating making any such additions or alterations are advised at the outset to examine carefully the design and construction of the index collars fitted to a best quality machine tool.

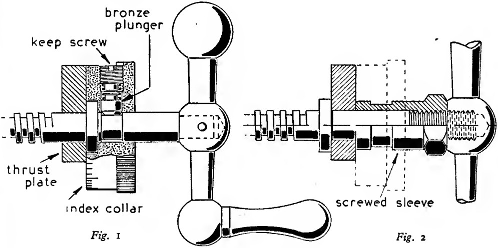


Fig. 1

Fig. 2

be furnished with an index collar or circular scale, graduated in thousandths of an inch, so that, when required, an exact predetermined amount of feed can be given to the tool, as opposed to the old-time method of making a chalk mark across the slide and giving the feed handle a slight tap, in order to turn a little more off the work before again applying the calipers.

When the lathe is properly equipped in this way, not only can the feeds be accurately controlled, but the lathe itself becomes a measuring instrument, or dividing engine, as it is called, capable of graduating linear scales and setting-off exact lengths, as well as carrying out ordinary turning operations with precision, thus saving both time and spoilt work.

If a precision or other high-class lathe is examined, it will be found, as might be expected, that expense has not been spared in providing the saddle slides with index collars that are finely finished and clearly engraved, besides being easily read and capable of being set to the zero position when required. In some of the more popular types of lathes, on the other hand, the cost of production may, in part, restrict

Fitting Index Collars

The first point to decide is which feed-screws are to be equipped in this way.

Most important of all, perhaps, is the cross-slide where an index is almost essential when turning work to an exact diameter. This index collar should be of sufficiently large diameter to enable the graduations to be easily read, and, of course, it must be readily adjustable to allow of setting to the zero mark when required.

The top slide should also be equipped with an index, but here a collar of smaller size and of the fixed pattern will probably suffice. A third index of large size should always be fitted to the lathe lead-screw, but this need not necessarily be of the adjustable type, for when it is set to zero the lathe tool is brought into contact with the work by means of the top-slide, after which the lead-screw is used to continue feeding the tool.

The Cross-Slide Index

As this index is so much used, it is essential that it should be large enough for the graduations to be easily read. When, as is usually the case,

the pitch of the feed-screw is 1/10 in., then if the diameter of the index is made 2 in., the hundred graduations denoting thousandths of an inch will be approximately $\frac{1}{16}$ in. apart, and for a $1\frac{1}{2}$-in. index they will have a spacing of nearly 1/20 in.

Needless to say, the index drum must not project above the surface of the cross-slide, or the setting-over of the top slide may be restricted thereby.

A simple but effective type of index for general use on the lathe slides is shown in Fig. 1. This index collar can be made of steel; or bronze will give a good appearance and is readily machined, but aluminium alloys are rather too soft for the purpose, as an index made of this material is easily damaged and defaced. If desired, the face of the collar bearing the graduations can be bevelled to facilitate reading the index lines. As will be seen in the drawings in Figs. 1 and 2, the index collar as it rotates is positioned endways by means of a bevelled plunger, travelling in a groove, cut either in the feed-screw, or in a sleeve attached to this shaft.

perpetual eyesore, but will also make the accurate reading of a closely-divided index a difficult matter.

To ensure a good appearance, therefore, these reference lines should always be machine cut, as will be described later when the operation of machining the graduations on the index itself is dealt with.

The Top-Slide Index

A similar type of index, although, if desired, of smaller size, can be fitted to the feed-screw of the top slide, but as this slide is generally used merely to engage the tool with the work, and it is seldom that an exact feed apart from that available from the lead-screw is required, a simple fixed index of small size will usually suffice in this position.

Fig. 3 illustrates an index collar of this form which is graduated in five thousandths of an inch only, and it will be seen that the index, which in this case serves also as a thrust collar, has a hexagon portion formed at its outer end to facilitate making the thrust adjustment before this is secured by the lock-nut. Although a fixed index of this pattern may be used as a thrust collar, the adjustable index must never be employed for this purpose, but should have ample end clearance to allow it to be positioned solely by means of the friction plunger.

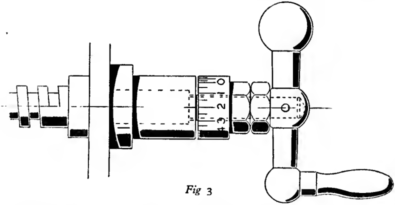


Fig 3

Frictional control of the collar is provided by means of a spring and keep-screw, so arranged that when the latter is fully tightened the plunger locks the index to the shaft. To give sufficient frictional contact for preventing inadvertent movement of the index, a strong spring is required; and a short length of Bowden outer casing has been found to serve this purpose well.

The whole of the frictional device can be conveniently accommodated in a 7/32-in. reamed hole, tapped $\frac{1}{4}$ in. by 40 threads per inch at its outer end to receive the keep-screw.

In the case of the index shown in Fig. 1, the end adjustment of the feed-screw is effected by means of a nut and lock-nut on the inner side of the thrust-plate, but in the type depicted in Fig. 2, this adjustment is made by turning the internally-screwed sleeve on which the index rotates, and here the feed handle serves as a lock-nut. An index line for reading the setting of the index is marked on the thrust-plate, or it may be necessary to cut this reference line on a small bracket attached to the thrust-plate, in order to bring the parts close together and so facilitate reading the index setting. A poorly-formed reference line, possibly cut with a file, will not only be a

The Lead-Screw Index

This is a most useful device which should not be omitted from the small general purpose lathe, and manufacturers now usually supply this fitting, either as a standard, or as an extra piece of equipment.

As has already been mentioned, this index can be of the fixed type, and this is considered an advantage by many, including the writers.

Fig. 4 shows a fixed index fitted to a Drummond lathe, now the Myford "M"-type lathe. As this particular index was made originally to serve as an adjustable index on the cross-slide of a large lathe, the figures are marked horizontally instead of vertically, as they should be for easy reading. To fit the index the hand-wheel was removed and its place was taken by a collar of equivalent width; the wheel was then secured to a truly-turned stub mandrel, held in the self-

centring chuck, and the inner boss of the wheel was turned parallel for a distance slightly in excess of the width of the index. Next, the index was set truly in the four-jaw chuck, with thin cardboard packings under the jaws to prevent damage to the graduated surface, and the bore was machined to afford a firm press-fit on the wheel boss. For the sake of convenience in operation, the index was pressed into place

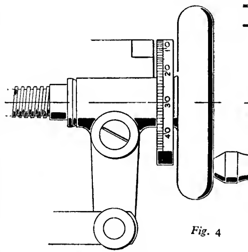


Fig. 4

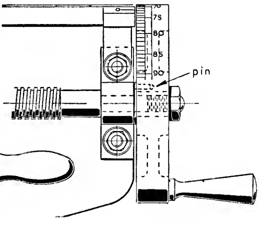


Fig. 5

with its zero directly opposite to the position of the handle, as shown in the drawing.

A small bracket, bearing a machine-cut index line, was attached to the rear end of the lathe bed to complete the operation.

The lead-screw index shown in Fig. 5, which replaces the normal thrust washer and adjusting nuts, has been fitted by the writer to a Myford lathe. Here, the index is mounted on a screwed sleeve, which screws on to the end of the lead-screw to provide the thrust adjustment; a locking collar is fitted to secure the index and at the same time to lock the sleeve, whilst a register pin fixed to the sleeve effectively locks the index from turning on the sleeve.

Making Index Collars

Machining the index body is a straightforward turning operation, and the piece of material selected is held in the chuck with a sufficient length projecting to allow of parting-off the finished part.

Face the end of the bar and drill it to the full depth, then bore to the finished size. When the bar has been turned to the required diameter, it is knurled with either a straight or a cross-cut pattern as desired. The plain outer portion which is to receive the graduations is then turned considerably less in diameter than the knurled part, in order to afford a good finger hold. If it is decided to form a bevelled surface for the graduations, this is turned to the required angle by setting over the top-slide; but note that this setting should be preserved for cutting the graduations at a later stage. A flat surface should be left beyond the bevel where the keep-screw is fitted.

The next step is to cut the graduations, and on the manner in which this work is carried out will largely depend the satisfactory appearance of the finished index.

Graduating the Index

The number and spacing of the graduations, each representing 1/1,000 in., will, of course, depend on the pitch of the feed-screw to which the index is attached; thus, if the screw is of 1/10 in. pitch, then 100 graduations will be required to indicate increments of 1/1,000 in., and where the pitch is ⅛ in., 125 graduations are needed. In some instances, feed-screws of 1/12 in. pitch have been fitted to lathes; this represents a feed of 0.0833 in. per turn. Now the nearest whole number to this figure is 80, and if the index were divided into eighty equal parts, there would be an error of more than three thousandths of an inch for each turn of the feed-screw. If, therefore, an accurately-controlled feed is desired, it is perhaps best to fit a new feed-screw and nut of 1/10 in. pitch.

Where a dividing head is available the indexing of the collar will present no difficulty, but as it is our aim, however, whenever possible, to carry out even intricate machining operations with simple equipment, an alternate method, using only the ordinary lathe accessories will be described. For this purpose, the lathe change-wheels are used, and a pointed detent, bolted to the lathe quadrant, is employed to engage the wheel-teeth and rigidly prevent their turning, for on the correct location of each wheel-tooth will depend the accuracy of the finished index.

A detent suitable for this purpose is shown in Fig. 6. Let us first consider the method of cutting 100 graduations, suitable for a feed-screw of 1/10 in. pitch.

If a 100-tooth wheel is available, this should be mounted on the tail-end of the mandrel, and by using every tooth space the indexing

becomes a simple matter. If there is no wheel of this size in the set of change-wheels, then mount a 50-tooth wheel, and obtain settings equal to each half-tooth by meshing with it a 20-tooth wheel, which is coupled on the same stud to a 40-tooth wheel. It will be apparent that if each tooth-space of the latter wheel is used for indexing, this will represent part of a revolution equal to a half-tooth of the 50-tooth wheel fixed to the mandrel, as shown diagrammatically in Fig. 7, and expressed arithmetically as :

$$\frac{50 \times 40}{20} = 100$$

That is to say, the number of teeth of the 50-tooth wheel is, in effect, doubled by gearing with it any two wheels which have a tooth ratio of 2 to 1.

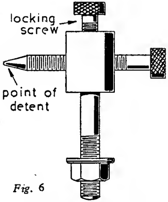


Fig. 6

In the same way, when 125 divisions are required, if a 100-tooth wheel is mounted on the mandrel it should mesh with a 20-tooth wheel which is coupled on the same stud to a 25-tooth wheel, and the detent is then arranged to engage the teeth of the latter wheel. Alternatively, the arrangement may be similar to that shown in Fig. 7, except that the 40-tooth wheel with which the detent there engages, is replaced by another 50-tooth wheel. If neither a 100-tooth nor a second 50-tooth wheel is available, a train of wheels must be used :

$$\text{mandrel wheel } 50 \rightarrow \frac{20}{40} \rightarrow \frac{25}{20} \leftarrow \text{detent}$$

which can be expressed as $\frac{50 \times 40 \times 25}{20 \times 20} = 125$, that is to say, the driving wheels are multiplied together and the product is divided by the product of the driven wheels.

Now, as the wheels used for screw-cutting are usually driven by means of keys or pins, and, in addition, some working clearance must be allowed when meshing the teeth, a small amount of backlash will always be present, and must be taken up if accurate indexing is to result.

This can be done conveniently by the method diagrammatically represented in Fig. 8. A cord attached to the chuck key is led over a pulley clamped to the bench, and to the end of the cord is fixed a weight sufficient to prevent the mandrel turning under the stress imposed by the engraving tool. If the cord is given a turn round the chuck, the tension on the cord will remain constant as the chuck is turned. The chuck key is used as a lever to hold and rotate the mandrel while the detent is engaged successively with the wheel teeth.

The dividing gear is now complete, and it remains to mount the engraving tool in position.

The tool used to cut the graduations is of V-pointed form, with an included angle of some 50 deg., but it is important to maintain, as far as possible, the strength of the extreme tip which bears the cutting stress ; and as it is no easy matter to replace a broken tool exactly in its former position, any undue weakening of the tool must be avoided at all costs. With this in view, clearances of only 5 deg. at both the sides and front edge of the tool are given, and the extreme tip only of the tool should be flattened by a few light strokes with an oilstone to give greater strength at this point. It is better to avoid using any top rake when cutting either steel or brass, otherwise the tool is apt to dig in and its point may be damaged.

The tool is mounted on its side at centre-height in the tool-post, and set at right-angles to the work face, in order to mtaintain the correct clearances and absence of top rake.

At this stage the length of the lines to be cut must be decided on, and this can perhaps best be done by measuring those on an index of good appearance, or by making a scale drawing and adding lines that look right. Two lengths of lines will usually be sufficient ; long lines for the 5 and 10 thousandths divisions and short ones for the intermediate graduations. Lines

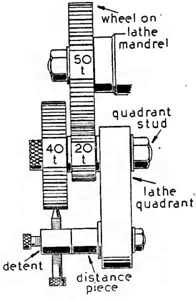


Fig. 7

of about ⅛ in. and 1/16 in. in length respectively, will generally be found to give the desired appearance, and at the same time are easily read.

The lines can be cut to the required length by reference to the lead-screw index, or, if this is not fitted, a change-wheel fixed to the lead-screw should be chalk-marked for reading against some fixed point on the lathe.

Alternatively, the top-slide, when set truly parallel with the lathe axis, can be used under the control of its index for engraving cylindrical work, but when a bevelled face has been formed the set-over top-slide must be used for cutting the graduations. If the tool does not travel exactly parallel with the surface of the work, the graduations will not be of constant depth or width throughout.

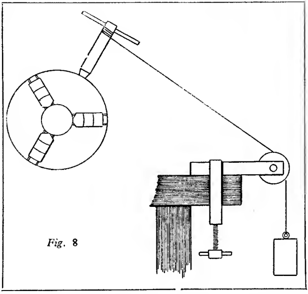


Fig. 8

After engaging the detent and setting the anti-backlash device, feed the tool inwards with the cross-slide until the tool just rubs against the work; then put on two thousandths of an inch of cut, and traverse the tool along the work for the required distance by means of the lead-screw or the top-slide, as the case may be; return the tool to its starting point, and take another cut after putting on a further feed of one thousandth; repeat this operation, thus making the depth of cut four thousandths, which should give the result required, but if desired the lines can be cut deeper and wider by taking additional cuts of not more than one thousandth of an inch at each traverse. To cut the second line the detent is withdrawn and then engaged with the next tooth space. This procedure is continued until all the graduations have been cut, bearing in mind that every fifth line must be of increased length to denote the 5 and 10 thousandths divisions. The next step is to part off the index a little longer than the finished length, and, after mounting it on a true-running stub mandrel, face it off to the correct length. The figures are then put on at every 10 thousandth mark by means of hand punches, but it is as well to practise this operation on a piece of scrap material before dealing with the index itself. Take care to punch the figures in the right direction so that they increase in value to represent the forward movement of the slide.

The chips adhering to the ends of the cut lines should be carefully broken off with a piece of brass, and the burrs formed when cutting the graduations and punching the figures should be removed with the index again mounted on the stub mandrel; a strip of fine emery cloth, supported by a smooth file, is then applied to the surface of the rotating work, until a good, uniform finish has been obtained.

Finally, clamp the adjustable index in the machine vice and drill a hole with a No. 3 drill, well clear of the graduations, right through to the bore. Ream this hole 7/32 in. and tap its outer end 7/32 in. by 40 threads per inch to receive the keep-screw. The brass or bronze plunger is turned to a good sliding fit without shake in its housing, and, as indicated in the drawing, both the plunger and the keep-screw are formed with a register spigot to maintain the spring centrally and clear of the bore.

The finished index can now be assembled on the feed-screw, and the length of the small spring is adjusted to give firm frictional control, and, at the same time, allow the index to be locked when the keep-screw is fully tightened.

News of the Trade

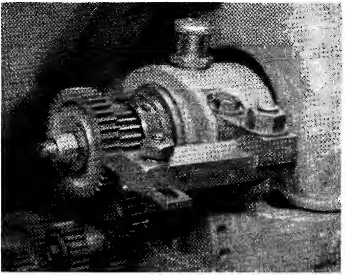
In these days of shortages and other difficulties of supply, it is pleasant to record an instance of a new miniature steam engine. From Gordon Green Ltd., 73, Cowley Road, Uxbridge, we have received a copy of a drawing giving arrangement and details of a twin-cyinder vertical steam engine. The design is of the simplest description and presents no difficulty in machining and erection. The twin cylinders are each ¾ in. bore and ⅞ in. stroke, and are provided with simple, eccentric-operated valves, no reversing-gear being included.

A set of castings for this engine has also been made available for our inspection; the castings are of bronze and seem to be of excellent quality.

The engine is of a type which should appeal especially to readers who possess only limited workshop equipment other than a lathe, since the amount of machining and fitting required is not great and seems eminently suitable for the novice.

A Simple Dividing Head for the M.L.7 Lathe

by A. R. Turpin



IT took some thought to find a fixing for a simple dividing-head for an M.L.7 lathe.

That shown in the photograph was finally decided upon, and the drawing, Fig. 1, gives the main dimensions.

The first operation was on the front bolt seating of the cap of the rear main bearing of the mandrel. This was machined dead flat with a counterbore, and a skim taken off the front face to make a true right-angle.

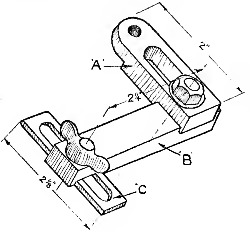


Fig. 1

A piece of $\frac{3}{4}$-in. $\times$ $\frac{1}{2}$-in. B.M.S. " A " was then cut to length and one end nicely rounded to fit snugly into the bolt seating. The under-side was rebated so that the edge of the rebate fitted square to the front face of the bearing cap. The two were then clamped together, and, using the cap as a guide, a $\frac{1}{4}$ in. clear hole drilled in the bar. Next, a $\frac{3}{8}$-in. slot was milled in the same bar, and this item was completed.

A bar of the same section " B " having two clearance holes drilled in it $2\frac{1}{4}$ in. apart, one $\frac{1}{4}$ in and the other $\frac{3}{8}$ in., was then made. Next, two slots are milled in this bar, both $\frac{1}{8}$ in. deep, with the holes central to them, that with the $\frac{3}{8}$-in. hole being $\frac{3}{4}$ in. wide to fit bar " A " and the other $\frac{1}{2}$ in. wide.

The third and last part " C " is made from a piece of tool steel $2\frac{1}{8}$ in. $\times$ $\frac{1}{2}$ in. $\times$ $\frac{1}{8}$ in. A $\frac{1}{4}$-in. slot is cut in this for practically its whole length and one end shaped to fit nicely between the teeth of a change-wheel. A $\frac{1}{2}$-in. bolt holds this strip to bar " B," and it will be found easier to manipulate if a square is machined below the head to fit in the slot so that the bolt does not turn when the nut is tightened. The change-wheel used for indexing is held on the mandrel by an expanding bolt similar to that described in *An Amateur's Workshop*, by Ian Bradley, and shown in Fig. 2. For convenience, a wing-nut may replace the hexagon-nut on the $\frac{1}{4}$-in. bolt.

Although the slot in bar " C " allows for some adjustment when different size wheels are used, the slot in bar " A " is primarily for this purpose.

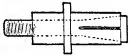


Fig. 2

The existing bolt in the bearing cap will have to be replaced by one $\frac{3}{8}$ in. longer.

This indexing bracket will also be found to be a convenient place to fix a Veeder counter when winding coils.

A striker can be fitted to a collar which can be slipped over the end of the expanding bolt in the same way as a change-wheel.

A Free-Lance Horizontal Engine

by H. Morton Webb

IN common with a great many other model engines built by fellow-enthusiasts, both past and present, the model depicted in the accompanying photograph has both a history behind it and a strong motive for its creation.

Some 25 years ago, the writer purchased, for a very small sum, an engine of similar type to the one about to be described, and for many years during his youth the old engine gave much pleasure to both the owner and friends alike.

However, during the early years of the war, a twin-cylinder vertical engine of my own design, then in course of construction, came to a standstill, due to certain materials vital to its completion becoming unobtainable. This situation left me faced with the problem of looking round for a job of model engineering which could be seen through to its logical conclusion with materials still available in my own "Stores."

The old horizontal engine was brought forth with the idea of doing a few improvements here and there. But, alas! when this engine, which in former years had been the high spot amongst my little collection of models, was stripped and the components laid out for inspection, my more mature experience forced me to the decision that the job as a whole had been made in such a slipshod way that it would prove a complete waste of time to attempt any small scale improvements to so many ill-fitting and crudely made components. As the old engine was, to say the least of it, a good-looker, it was finally decided to build a replica of this friend of former years, using the existing bed and cylinder castings as a foundation. The possibility of obtaining new castings being out of the question at that time. Very many hours' work with file and scraper were necessary before either the bed or cylinder castings could be passed as good enough to form the basis of the new engine. Two other items were also salvaged, i.e., the flywheel and crankshaft, the latter component being used purely as a suitable-shaped piece of steel from which to machine a new crankshaft.

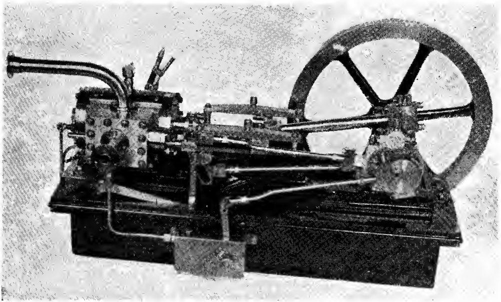


Photo by] [*N. Dibble, Bristol*

Side-view of the free-lance horizontal steam engine, showing details of gearing

It is only too true that far more time and patience were needed to reclaim these items than would have been necessary to machine up new and unspoiled castings.

A start was made on the working parts of the engine, and wherever possible the components forming various sub-assemblies were machined up and fitted together ready for final assembly before proceeding with the next batch of parts. This system was adopted in view of the fact that the engine was largely "made to measure," dimensioned sketches only being prepared for the more vital parts, such as connecting-rod, valve and valve-gear, etc.

Considerable time was expended in an effort to obtain a high finish on the components, all

items in steel, being hand stoned with fine grade carborundum slips, followed by a further treatment with soft slips obtained from cylinder hones. These two processes removed all trace of tool-marks, a final polish being obtained by the use of worn-out emery-cloth dusted with jewellers' rouge.

Due to my equipment, during the war, being limited to a 3-in. non-precision treadle lathe, small sensitive drill, and hand-operated bench drill, plus a goodly assortment of hand-tools, several of the larger components had to be made by rather roundabout methods. The forked connecting-rod, $5\frac{13}{16}$ in. centres, was one case where fabrication from three separate components was resorted to. Production of this particular part may constitute an all-time record for slowness, as some 146 hours spread over five months was expended before the completed rod with white-metalled brasses and oil cups was ready for assembly. On another occasion, over two weeks' spare time was put into the making of a special attachment for milling the slot and profile of the expansion link. By the time the engine was finally assembled, some 310 components had been made, and the time-sheet showed over 1,400 man-hours from start to finish.

A few further points which may be of interest comprise the provision of a geared-down reversing-lever, whereby ample angular movement is available at the quadrant to accommodate the spacing of the latch slots which cover a range of cut-offs from 85 per cent. to 30 per cent. either side of mid-gear. Also a large ratchet-operated oil pump located on the valve side of the engine, which provides ample oil capacity for continuous running.

Leading dimensions of the engine are : Bore, $1\frac{9}{16}$ in. ; stroke, $2\frac{5}{16}$ in. ; flywheel, $8\frac{3}{4}$ in. dia. ; crankpin, $\frac{7}{16}$ in. dia. ; journals, $\frac{1}{2}$ in. dia. ; overall length, 17 in. ; overall height (excluding flywheel), $7\frac{1}{2}$ in. ; weight, 25 lb.

The engine has been tested under low-pressure steam with very gratifying results, demonstrating to the full that silent rhythmic poetry of movement which, in the writer's opinion, can only be achieved by an open-type steam engine.

At the time of writing, an 8-in. diameter horizontal return-tube boiler is under construction, and should supply ample steam to operate the engine under full load conditions, as well as forming the basis for a comprehensive stationary steam plant.

The Model Power Boat Association

AT the annual general meeting held on Saturday, March 13th, 1948, the following decisions and amendments to rules were made :

In future, boats for circular-course racing must be provided with either a bridle, single line or some other fixing, the length of which shall be 24 in. to the centre-line of the boat. The actual tethering line will be shortened to compensate for this. The line may be either textile fabric or metal, but must withstand under test 120 lb. for A Class boats, 80 lb. for B Class and 50 lb. for C Class.

Boats may be attached at one, two or more points at the option of the competitor. The fixing must be tested to withstand a breaking strain not less than that of the line. The bridle or other fittings must be flexibly attached to the hull so that they do not constitute an artificial stabiliser.

Identification numbers, preferably by fixed markings, were made compulsory for all boats running in regattas.

A definition of boats eligible for competitions was agreed, the main points of which were as follows : The term "model power boat" shall refer to craft capable of travelling in or on water and driven by a self-contained motive power such as an electric motor, steam engine or internal combustion engine. Propulsion of boats must be by mechanical means, acting on the water through the medium of a partially or completely submerged screw propeller, paddle wheel or similar mechanical reactor. In the case of hydroplanes, the use of aerofoils or other means to obtain partial or complete air lift of the craft is forbidden, and the bottom of the main structure must not rise more than one inch above the surface of the water when the boat is in normal running attitude.

It was decided that A, B and C class racing hydroplanes should not be allowed to race out of their own classes.

It was agreed that the silencing of noisy engines is desirable, and the application of silencers is to be considered by the committee, as is also the institution of a club championship.

Regatta Fixtures

The following dates were provisionally fixed :—

May 16th (Whit Sunday), Wicksteed.
May 17th (Whit Monday), Bourneville.
May 23rd, Victoria.
June 6th, International.
June 20th, Malden.
July 4th, South London.
August 8th, West London.
August 15th, Guildford.
August 29th, Grand Regatta.
September 12th, Blackheath.

Election of Officers

The following were elected as officers and committee of the Association :

President, E. W. Vanner ; vice-presidents, Messrs. Percival Marshall, F. J. Pierson and F. Bontor ; chairman, E. T. Westbury ; Hon. Secretary, J. H. Benson ; Hon. Assistant Secretary, A. Rayman.

Committee and Club Representatives

Messrs. J. B. Skingley (Victoria), W. Whiting (Orpington), J. Cruickshank (Victoria), E. A. Walker (Malden), A. F. Weaver (Victoria), L. S. Pinder (Malden), A. W. Stone (South London).

All enquiries on any matters connected with the M.P.B.A. should be made to the Hon. Secretary, J. H. Benson, 70, Broadfield Road, Catford, S.E.6. Telephone : Hither Green 1486.

Editor's Correspondence

An Unusual Locomotive Valve Gear

DEAR SIR,—Some time ago I came across a rather unusual adaption of radial valve-gear applied to a small and ancient 0-6-0 tank locomotive, on one of the "Kleinbahns" or light railways in Germany.

At the time, I had no opportunity of taking any actual dimensions of the gear, but I made out sketches, which give the general layout of the linkage.

Possibly these may be of interest to your readers. Personally, I have no recollection of ever having seen this gear applied to a locomotive in this country, and it would be interesting to know whether any of your readers are acquainted with it.

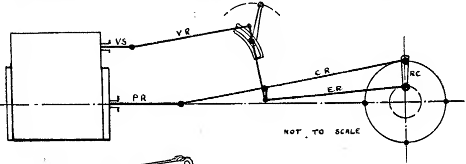
It will be seen that there is a resemblance to the Joy gear, by the inclusion of a curved slide-shaft and swing link, but the bottom end of the "stirrup link" in this instance is connected by means of an eccentric-rod to a return crank, set "in phase" with the main crankpin.

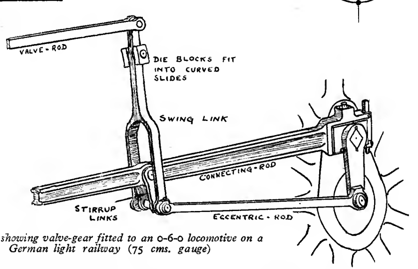
I should think there is not much to choose, from a constructional point of view, between this gear and the more usual Walschaerts arrangement for an outside-cylinder loco, and possibly the radial gear would be subject to greater inaccuracies in steam distribution, due to the vertical movement of the driving axleboxes in the horns.

It would, however, be interesting to study the steam distribution on a model of this gear, even if made up of cardboard strips and paper fasteners in the manner often mentioned by L.B.S.C., and when time permits, I shall have to look more fully into its possibilities.

Yours faithfully,

Louth. JOHN R. BURDETT.





Sketches showing valve-gear fitted to an 0-6-0 locomotive on a German light railway (75 cms. gauge)

Small Locomotives

DEAR SIR,—*Re* the claim of the Tyneside Society of Model and Experimental Engineers (February 19th, 1948 issue) that the 2 mm. scale locomotive demonstrated at their recent exhibition is the smallest working locomotive in the world, I would like to point out that at least one other locomotive exists which is equally as small, if not smaller.

Some time ago I constructed an electrically-driven locomotive of the "Coronation Scot" type, to the following dimensions: length (less tender) $3\frac{3}{8}$ in., width $\frac{5}{8}$ in., height $\frac{15}{16}$ in., track $\frac{5}{16}$ in., which I believe represents about $1\frac{3}{4}$ mm. scale.

Yours faithfully,

Yeadon. A. E. SCOTT.